(11) (A) No. 1 140 845

(45) ISSUED 830208

(52) CLASS 154-53.03

(51) INT. CL.^{3} B29D 23/00

(19) (CA) CANADIAN PATENT (12)

(54) HOSE

(72) Nixon, Peter J.;
Whittaker, Keith;
Harrison, David;
Sheard, Dennis R.,
U.K.

(73) Granted to Angus Fire Armour Limited
U.K.

(21) APPLICATION No. 363,103

(22) FILED 801023

No. OF CLAIMS 13

ABSTRACT

IMPROVEMENTS IN OR RELATING TO HOSE

A hose comprising a thermoplastic elastomer liner (1), a textile reinforcement layer (2) and thermoplastic elastomer cover (3). The liner (1) is bonded to the reinforcement layer (2) by a hot melt polyester adhesive (4) the melting point of which is below that of the liner. The hose is suitable for transporting a wide range of fluids including hydrocarbon fuels, organic liquids, solvents and drinking water.

The preferred materials for the liner (1) and cover (3) are polyetherester elastomers and polyurethane elastomers respectively and the adhesive preferably has a melting point at least 20°C below that of the liner material.

A method of manufacturing the hose in which the adhesive coated liner (1) is inserted through an assembly comprising the reinforcement layer (2) and cover (3) and subsequently inflated and heated to effect bonding of the liner (1) to the reinforcement layer (2) is also disclosed. Use of a preformed liner (1) and heat reactivatable adhesive (4) enables hose to be made in continuous unspliced lengths greater than 250 feet by this method.

DAW/JMT - FH.5986

IMPROVEMENTS IN OR RELATING TO HOSE

This invention concerns improvements in or relating to hose and in particular, though not exclusively, to layflat hose suitable for transporting a wide range of fluids.

Layflat hose for certain applications may comprise a fluid impervious inner layer chemically and physically inert to the fluid to be transported, a textile reinforcement layer to provide the required burst strength and an outer cover to protect the reinforcement layer from damage caused by abrasion during handling.

Conventionally the liner has been made from a rubber based material and the hose is made by extruding the liner, inserting the unvulcanised liner into a textile reinforcement jacket onto which the outer cover has previously been extruded and subsequently inflating the assembly with steam under pressure to vulcanise the liner and effect bonding of the liner to the reinforcement jacket.

There has been a trend away from conventional vulcanisable rubber-based materials towards thermoplastic elastomers for the liner, thermoplastic elastomers being both lighter than and chemically and physically inert towards a wider range of fluids than the conventional vulcanisable rubber-based materials thus enabling a given hose construction to have a much wider range of applications.

However this change has resulted in a problem in obtaining a sufficiently strong bond between the thermoplastic elastomer of the liner and the textile reinforcement

layer which is maintained both under the operating conditions and in the event of fluid leakage through the liner. This adhesion problem is due to the lack of polar chemical groupings in the known thermoplastic polyetherester elastomers used for the liner and is greatest when the textile reinforcement layer is made of polyester or polyamide material. As a result it has been necessary to use an adhesive to bond the known thermoplastics liners to the reinforcement layer. To date adhesives applied from solvent based solutions or pastes containing at least 30% of solvents such as chlorinated hydrocarbons, generally using two component systems followed by evaporation of the solvent, have been used and it has been found that the residual tack and frictional characteristics of the resultant adhesive coated liner effectively restricts the length of liner which can be inserted into the textile jacket without stretching or distorting the liner to about 200 feet. Furthermore, as a result of leakage through either the liner or cover, it has been found that the adhesive bond between the liner and reinforcement layer is rapidly weakened by contact with certain fluids e.g. hydro-carbon fuels, leading to hose delamination and consequently the hoses are unsuitable for transporting such fluids.

It is an object of the present invention to provide a hose having a thermoplastic liner which reduces at least some of the above-described disadvantages and can be used to transport a wide range of fluids including hydrocarbon fuels.

According to the present invention we provide a method of making a hose having a continuous unspliced length of greater than 250 feet comprising an inner liner of a thermoplastic elastomer, a textile reinforcement layer and an outer cover of a thermoplastic elastomer in which said liner is bonded to said reinforcement layer by a hot melt polyester adhesive, comprising the steps of forming said reinforcement layer, applying said outer cover thereto, forming said liner and applying a hot melt polyester adhesive to the external surface thereof, said adhesive having a melting point below that of said liner material, inserting said adhesive coated liner through said reinforcement layer, passing a fluid medium into said liner to inflate the assembly so formed, applying heat to said assembly sufficient to activate said adhesive and effect bonding of said liner to said reinforcement layer.

Preferably the polyetherester elastomer of the inner liner has the following characteristics:

mpt (ASTM D 2117)	:	156-210°C,	preferably 164-200°C
Hardness (ASTM D 2240)	:	35-45D,	preferably 37÷43D
Melt Index 190°C 2160G g/10 min (ASTM D 1238E)	:	2-8,	preferably 4-6.5
Tensile Strength (ASTM D 638)	:	15-30 MNm^{-2} min	preferably 19-26 MNm^{-2} min
Elongation at Break	:	400% minimum	

Suitable elastomers are those sold under the Registered Trade Marks of Hytrel (ex Du Pont) and Arnitel

(ex AKZO).

The melting point of the polyester adhesive should be such that the integrity of the hose remains substantially unaffected by the temperatures to which the hose is generally subjected under normal operating conditions. At the same time the melting point should be sufficiently below that of the liner material, preferably at least 20°C

below that of the liner material, so that during manufacture of the hose an increase in temperature to activate the adhesive and effect bonding of the liner to the textile reinforcement does not cause appreciable softening of the liner which could result in undesirable changes in the liner thickness.

An adhesive which meets the above criteria and is suitable for use with a liner material having the above-mentioned preferred characteristics has a melting point of not less than 100°C more preferably not less than 130°C. An example of a suitable adhesive is that sold under the Registered Trade Mark Grilesta 6506 (ex Grilon) which has a melting point in the range 100 - 140°C more preferably 130 - 140°C and a viscosity of 6500 poise at 160°C and 2160 gram load (DIN 53735).

The jacket may be of any known construction, for example knitted braided or woven to produce a balanced construction having the required strength characteristics for a given application. Alternatively the jacket may be of non-woven construction e.g. a spiral winding. Preferably the jacket is of woven construction comprising one or more layers made from natural or synthetic textile material, for example cotton, polyester, polyamide or polyvinyl acetate. A suitable aromatic polyamide is that sold under the Registered Trade Mark Kevlar (ex Du Pont).

Preferably the warp and weft yarns of the jacket are pretreated with a heat reactivatable resin during production to improve the adhesion of the hot melt polyester

adhesive. Suitable yarns are those sold under the Registered Trade Mark Diolen 164S. (ex British Enkalon).

The polyurethane elastomer of the cover may be selected from the group consisting of polyester, polyether, polyester caprolactone and polyesterether type. Polyester caprolactones are preferred as these exhibit good resistance not only to abrasion and cutting caused by handling but also to a wide range of fluids including hydrocarbon fuels. Preferred polyurethanes are those which are free from low molecular weight oligomers and from waxes, lubricants and other low molecular weight processing aids. Suitable polyester caprolactones are those sold under the Registered Trade Marks Caprolan (ex Elastogram) and Rowathane 1080 (ex Rowa GmbH).

In addition to the improved chemical and physical resistance to a wide range of fluids including hydrocarbon fuels, hoses according to the present invention having a thermoplastics liner can be made in continuous unspliced lengths greater than 250 feet by conventional methods, for example lengths greater than 500 feet can be made.

The invention will now be described in more detail by way of example only with reference to the accompanying schematic drawing which shows in cross-section a hose according to the present invention.

The hose shown in the accompanying drawing comprises a polyetherester (Hytrel) liner 1 bonded to a polyester (Diolen 164S) jacket 2 by a hot melt polyester adhesive 4 (Grilesta 6506) and an outer polyurethane Caprolan

cover 3.

The liner 1 is made by hot melt extrusion of the polyetherester and is subsequently coated with the adhesive 4 by cross head or slot die extrusion.

The jacket 2 of circular woven construction is formed separately and subsequently coated on a mandrel with the polyurethane cover 3 by cross-head extrusion. Extrusion of the cover material is such that sufficient penetration into the textile jacket 2 occurs to allow some direct adhesion between the adhesive 4 applied to the liner 1 and the cover material, thereby helping to prevent delamination.

The mandrel is then removed from the polyurethane covered jacket 2 and the adhesive coated liner 1 is drawn through the jacket by any conventional technique.

The hose assembly is then inflated with air to a pressure above atmospheric to position the liner 1 within the jacket 2 and then the air is replaced by steam at 40 psi at a temperature of 140°C for 5-10 minutes to activate the adhesive and effect bonding of the liner to the jacket. Blistering of the liner by any gases or vapour trapped between the liner and cover can be prevented by replacing the steam with air at pressure above atmospheric pressure and allowing the bonded hose to cool whilst still inflated. Blistering of the cover 4 can be prevented by pin-holing the cover during extrusion of the cover material onto the jacket 2.

Alternatively blistering may be prevented by thoroughly drying the hose assembly at a temperature below

the activation temperature ofthe adhesive e.g. by passing air through the space between the liner and cover whilst heating the assembly, for example, by steam passing through the liner.

The hose according to the present invention, which can be made in continuous unspliced lengths greater than 500 feet exhibits good chemical and physical resistance to a wide range of fluids both when transporting and when exposed to the fluids. The hose may be installed as a permanent supply line or may be used to effect a temporary repair to a damaged supply line or simply to transport fluid from a fixed outlet to a delivery point. The range of fluids which can be transported by the hose include hydrocarbon fuels, e.g. petrol, chemical solvents, organic fluids and drinking water.

The embodiments of the invention in which the exclusive property or privilige is claimed are defined as follows:

1. A method of making a hose having a continuous unspliced length of greater than 250 feet comprising an inner liner of a thermoplastic elastomer, a textile reinforcement layer and an outer cover of a thermoplastic elastomer in which said liner is bonded to said reinforcement layer by a hot melt polyester adhesive, comprising the steps of forming said reinforcement layer, applying said outer cover thereto, forming said liner and applying a hot melt polyester adhesive to the external surface thereof, said adhesive having a melting point below that of said liner material, inserting said adhesive coated liner through said reinforcement layer, passing a fluid medium into said liner to inflate the assembly so formed, applying heat to said assembly sufficient to activate said adhesive and effect bonding of said liner to said reinforcement layer.

2. A method of making a hose according to claim 1 wherein said adhesive has a melting point not less than 100°C.

3. A method of making a hose according to claim 2 wherein said adhesive has a melting point not less than 130°C.

4. A method of making a hose according to claim 1 wherein said adhesive has a melting point at least 20°C below that of said liner material.

5. A method of making a hose according to claim 4 wherein said adhesive has a melting point in the range 130°C to 140°C and said liner material has a melting point in the range 156°C to 210°C.

6. A method of making a hose according to claim 1 wherein said liner material is a polyetherester elastomer.

7. A method of making a hose according to claim 1

wherein said cover material is a polyurethane elastomer.

8. A method of making a hose according to claim 7 wherein said polyurethane elastomer is a polyester caprolactone.

9. A method of making a hose according to claim 1 wherein said fluid medium is at an elevated temperature.

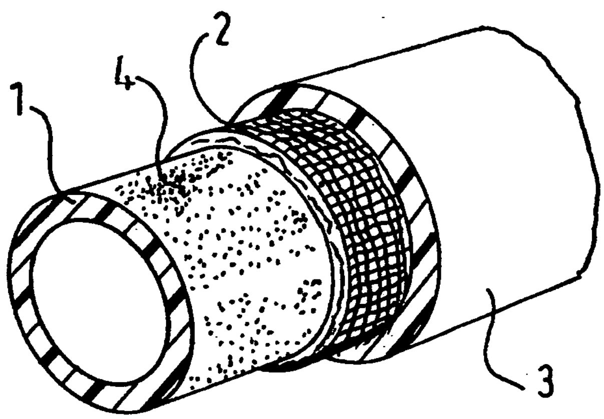
10. A method of making a hose according to claim 1 wherein subsequent to bonding said liner to said reinforcement layer said assembly is cooled whilst still inflated.

11. A method of making a hose according to claim 1 wherein prior to inflating said assembly a fluid medium is passed between said liner and said reinforcement layer to dry said assembly without activating the adhesive.

12. A method of making a hose according to claim 1 wherein said reinforcement layer is pretreated with a heat reactivatable resin prior to applying said cover.

13. A method of making a hose according to claim 1 wherein said hose has a continuous unspliced length of greater than 500 feet.

1140845



INVENTORS

PETER JOHN NIXON
KEITH WHITTAKER
DAVID HARRISON
DENNIS RICHARD SHEARD

Patent Agents

Fetherstonhaugh & Co.